

Inserting Meanders into the Ballona Creek Channel

Origin of the Engineered-Meander Proposal & Project Timeline since 2010

Revision 2.7 — April 30, 2026

A structured timeline drawn from CDFW EIR/EIS reference materials, USACE Los Angeles District public notices, the State Coastal Conservancy record, the Bay Foundation / EPA climate-change study, California Superior Court filings, and the Ballona Creek Terminus Report (McMahon, v5.72, Feb 28, 2026).

This report was researched, directed, and authored under human oversight. The analytical framework, evidentiary priorities, regulatory arguments, and document architecture were developed and managed by the author. Three AI systems — Claude (Anthropic), ChatGPT (OpenAI), and Perplexity — were employed as research and peer review tools under the author's direction, consistent with an established triple-AI methodology designed to minimize hallucination and maximize citation accuracy.

Date	April 30, 2026
Version	v2.7 — Executive Summary restructure: removed the SCCWRP Corrigenda framing paragraph (relocated to the dedicated Implications section as a three-item hook); removed the Terminology Note paragraph (promoted to its own H2 section, 'Terminology and Documentary Baseline,' between the ES and the Origin section); ES now opens with Scope of this report.
Scope	Origin of engineered-meander proposal · Project timeline since 2010 · Implications of the SCCWRP Corrigenda
Revision history	See Revision History section preceding the closing colophon.

Executive Summary

Scope of this report. This report evaluates the historical and geomorphic fidelity of the proposed channel design; it does not assess ecological performance or policy merits of the restoration project. The April 20, 2026 SCCWRP Corrigenda to TR 671 and its implications for the EIR document set are addressed in a dedicated section below; the present summary focuses on the origin and geomorphic basis of the engineered-meander proposal.

The proposal to remove the concrete Ballona Creek flood-control levees and replace the straight trapezoidal channel with a sinuous, engineered earthen channel running through a re-graded floodplain did not originate with the 2017 Draft EIR/EIS or with any single individual. It was introduced as Alternative 5 ("Alt5") in the Ballona Wetlands Restoration Feasibility Report prepared by Philip Williams & Associates (PWA) in 2008 for the California State Coastal Conservancy, working with the California Department of Fish and Game, the State Lands Commission, and a Science Advisory Committee convened by SCCWRP.^{1,2}

On October 15, 2008, the Science Advisory Committee recommended that both Alternatives 4 and 5 be carried forward — not Alt5 alone. The SAC described Alt5 as the option that "would result in the greatest amount of contiguous wetland habitat" while simultaneously flagging it as the alternative that "makes the greatest change to the site, would be the hardest to reverse and consequently has the most risk," enumerating five unresolved issues that would have to be addressed if Alt5 became the preferred alternative.² PWA then produced Revised Alternative 5 ("RevAlt5") in 2009, modified to address cost, infrastructure constraints, and sea-level rise by replacing the flat marsh plain with a continuous slope from subtidal to upland.¹

These two design concepts — the levee-removed, engineered-sinuous channel of Alt5 and the SLR-adapted RevAlt5 — became the technical foundation for Alternatives 1 and 2 in the 2017 Draft EIS/EIR, both of which specify a "sinuous (i.e., non-linear) Ballona Creek channel with two primary meander-shaped bends."^{3,4} The recent (post-2023) addition of new meander geometry to the revised EIR is not a new idea — it is a hydraulic re-engineering of the same 2008–2009 PWA concept, forced by the May 17, 2023 Grassroots Coalition v. CDFW ruling requiring corrected flood-capacity design parameters (the 68,000 cfs flow).^{5,6}

Three Findings at a Glance

First introduced. 2008 — PWA, Ballona Wetlands Restoration Feasibility Report, prepared for the California State Coastal Conservancy.

First proponents. Lead agencies (CDFG / SCC / SLC), the project's consultant team led by Philip Williams & Associates, and the SCCWRP-convened Ballona Wetlands Science Advisory Committee (which formally recommended Alt5 forward on Oct 15, 2008).

Reason for recent re-addition. The May 17, 2023 Superior Court ruling (Judge James C. Chalfant) ordered CDFW to redo flood-control design analysis. The increase from 46,000 cfs to 68,000 cfs design flow forces a new channel cross-section and meander geometry in the revised EIR, which CDFW decertified on Sept 28, 2023.^{5,6,7}

Terminology and Documentary Baseline

No documentary or survey evidence indicates the presence of a sinuous meandering channel extending to the sea on the lower Ballona Creek. Per the federal survey record (Hancock, 1857–58) and the court-certified Courtney Partition Map (District Court Case No. 965, 1867–68), Ballona functioned as an intermittently closed coastal lagoon (the best-supported interpretation of the mid-19th-century documentary record) — Hancock's "interior lake" with a 5–6 ft inlet whose "connection with the sea is often obstructed," and a documented inland extent of approximately 1.6 miles.²³ Historically the system was a spring-fed upland watershed connected to a terminal lagoon complex through a network of seasonal meanders, marsh distributaries, and lagoon inflows; it was not a river-mouth estuary, and the 1815–1825 LA River avulsion toward Ballona was a temporary anomaly superimposed on a predominant southward course through the Dominguez Gap to San Pedro Bay.²³ The channelization project (LA County ca. 1920; USACE concrete works 1935–1939, complete c. 1938) severed the spring-fed upland → terminal lagoon connection and converted the seasonal meanders and distributaries into a single concrete trapezoidal channel discharging directly to the ocean.^{8,9,23} The current proposal is therefore to insert engineered meanders into a redesigned channel within a re-graded floodplain — not to "restore" a meandering channel that historically ran to the sea.

Origin of the Engineered–Meander Proposal

Ballona Creek was straightened by Los Angeles County beginning ca. 1920 and concreted by the U.S. Army Corps of Engineers between 1935 and 1939 (channel substantially complete by approximately 1938), with tributaries channelized in the 1950s.^{8,9} Pre-channelization, the lower watershed was a spring-fed upland system draining through seasonal meanders, marsh distributaries, and lagoon inflows into a terminal lagoon complex behind a barrier — the "interior lake" Hancock documented in 1857–58 with a 5–6 ft inlet "often obstructed" by sand-berm closure.²³ The historical baseline is an intermittently closed coastal lagoon, not a river-mouth estuary (the best-supported interpretation of the mid-19th-century documentary record); no documentary or survey evidence indicates that the lower channel carried a sinuous meandering course to the sea. The 1815–1825 LA River avulsion toward Ballona was temporary; the river's predominant course was southward through the Dominguez Gap to San Pedro Bay.²³ The mechanism of the 1825 event itself is now best understood as the catastrophic failure, in April 1825, of a 10–15 ft debris dam approximately two-thirds of a mile in length that had formed in the LA River corridor circa 1815 — a 1815–1825 two-event causal chain documented by Crandell (1994) on the basis of contemporaneous accounts, with no earthquakes implicated in either event.³⁰ The spring inventory underlying this baseline is anchored primarily in Hall (1888) and the Reagan (1917) record as compiled in the Terminus Report; SCCWRP TR 671 (Dark et al. 2011) provides a corroborating distributional map but is now under formal Corrigenda (April 20, 2026) and is therefore treated in this revision as supporting rather than primary.^{23,24,26} Historical mapping identifies approximately 45 freshwater springs within the Ballona watershed; order-of-magnitude estimates derived from 19th-century measurements (Hall 1888 in particular) suggest combined spring discharge on the order of several million gallons per day (≈2–5 MGD), a synthesized estimate rather than a basin-wide measured total.²⁴ Modern field measurements indicate a reduction on the order of ~95%+ relative to historical estimates, with springs now contributing only ~2% of dry-season baseflow (29 active springs aggregating ~13,000 gpd in 2011).²⁵ Channelization (1920–1938) severed the spring-fed upland → terminal lagoon connection and converted the distributary system into a single engineered ocean-discharge channel.^{8,9,23} The idea of removing the existing flood-control levees and inserting an

engineered, sinuous earthen channel through a re-graded floodplain entered formal restoration planning in two distinct phases.

Phase 1 — Conservancy planning (2004–2007)

On March 20, 2000, the State of California entered into a Feasibility Cost-Sharing Agreement (FCSA) with USACE to initiate a Ballona feasibility study.¹⁰ On January 29, 2004, the State Coastal Conservancy authorized \$200,000 to SCCWRP to convene a Science Advisory Committee of approximately a dozen scientists with expertise in wetlands restoration and estuarine ecology, working in coordination with the Conservancy, DFG, and the State Lands Commission.¹¹ Environmental Science Associates (ESA) was retained in 2005 to develop alternatives, working with the Conservancy, the SAC, and regulatory and public stakeholders.¹²

Phase 2 — Feasibility report & SAC review (2008)

After public input, five conceptual alternatives were developed by the project's consultant team (PWA et al.), running on a continuum from preservation-only to full tidal restoration with "partial realignment and restoration of the lower portions of Ballona Creek/Flood Control Channel."² The defining document is PWA, 2008. Ballona Creek Wetlands Restoration Feasibility Report. Prepared for the California State Coastal Conservancy — cited by the Bay Foundation / EPA Climate Ready Estuaries study as the source of Alt5 design figures.¹

The Bay Foundation / EPA report (Bergquist, Pal, Trott, Brown, Wang & Luce, 2012; edited by Karina Johnston) records the technical definition verbatim:

"Alternative 5 (Alt5) involves removing the Ballona Creek flood control levees and excavating fill alongside the Creek to allow the Creek to meander through its floodplain."¹

The October 15, 2008 SAC memo to the Project Management Team recommended that Alternatives 4 and 5 both be carried forward to the next phase of analysis. The SAC's evaluation was scoped explicitly to ecosystem-restoration goals and was "not based on other project considerations of cost, logistics, or feasibility," and the Committee excluded the Feasibility Report's sections on public access and costing from its endorsement.² The SAC also invited the Project Management Team to develop a "hybrid" alternative incorporating elements from several alternatives — a design path subsequently followed in the 2017 Draft EIR's Alternatives 1 and 2 (sinuous channel with two primary meander bends).²

What the SAC actually said about Alt5. The Committee described Alt5 as the option that "would result in the greatest amount of contiguous wetland habitat and would have the least artificial structures or impediments," but simultaneously characterized it as the alternative that "makes the greatest change to the site, would be the hardest to reverse and consequently has the most risk." The memo enumerated five unresolved issues that "would need to be addressed should it become a preferred alternative":²

- Effect of erosive shear stress associated with high-velocity storm flows on sustainability of the marsh plain.
- Ability to manage adverse effects of pollutant input until upstream watershed-management measures reduce contaminant loading.
- Inclusion of additional upland habitat as buffer (e.g., restoring Area C as primarily upland or transitional habitat).
- Lack of control structures to accommodate sea-level rise, and refined analysis of potential flood elevations and associated implications for integrity of the restored wetland... if the Ballona Flood Channel levees are removed — including the need for new/additional flood-protection measures.
- Ability to implement Alt5 in phases so that impacts to existing species and habitats can be minimized.²

Risk rankings (Table 1 of the memo). Alt5 received the lowest ranking on five measures of change: flood management, resilience to episodic events, lack of impact to existing habitats, risk of terrestrial invasion, and intensity of maintenance needs. Alt5 received the highest ranking on habitat connectivity, tidal circulation, and stormwater/freshwater inputs; Alt4 ranked highest on quality of estuarine habitat and capacity to support sustainable wetland-dependent populations.² This ranked, qualified endorsement — not an unconditional approval — is the technical record on which the 2009 PWA RevAlt5 redesign was predicated.

Phase 3 — Revised Alternative 5 (2009)

PWA produced RevAlt5 in 2009 to respond to the SAC's flagged concerns and incorporate sea-level-rise resilience. The Bay Foundation report describes the revision precisely:

"RevAlt5 was modified to account for cost and infrastructure constraints, and to include a continuous slope from subtidal through upland habitats to allow the migration of habitats in the event of sea level rise (SLR)."¹

The companion PWA SLR document is PWA, 2009. Ballona Wetlands Restoration: Planning for Sea Level Rise, authored by Garrity, Lowe & Haltiner.¹ RevAlt5 reduced the channel's absolute meander amplitude relative to Alt5 ("in RevAlt5 the channel meanders less than in Alt5"¹) but kept the foundational principle of removing concrete flood-control levees and re-establishing a sinuous creek through its floodplain.

Timeline of Key Milestones (2010 – 2026)

The 2008–2009 PWA design concept was carried into NEPA/CEQA review from 2011 onward and survives, in modified form, into the 2026 revised EIR currently in preparation.

Pre-2010 Anchors

- 2000** USACE Feasibility Cost-Sharing Agreement signed
On March 20, 2000, the State of California signed an FCSA with the U.S. Army Corps of Engineers to initiate a Ballona feasibility study.
Federal Register Vol. 76, No. 98 (May 20, 2011), p. 29225.¹⁰
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- 2004** State Coastal Conservancy funds the Science Advisory Committee
Conservancy authorizes \$200,000 to SCCWRP to convene a 12-scientist Ballona Wetlands Science Advisory Committee, supplementing \$750,000 previously authorized for data collection and alternatives development.
SCC Staff Recommendation, Jan 29, 2004 (File No. 04-088).¹¹
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- 2005** ESA retained as restoration/EIR consultant
Environmental Science Associates engaged to develop alternatives and the restoration plan, including the Ballona Creek flood-control channel, working with Conservancy, SAC, and stakeholders.
ESA Project Description.¹²
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- 2008** » PWA Feasibility Report introduces Alt5 (meandering creek)
Philip Williams & Associates, Ballona Wetlands Restoration Feasibility Report, prepared for the California State Coastal Conservancy. Alt5 = remove flood-control levees + let Ballona Creek meander through its floodplain. SAC recommends Alts 4 & 5 jointly be carried forward on Oct 15, 2008, while flagging five unresolved issues with Alt5 (highest-risk, hardest-to-reverse).
PWA 2008, cited in Bergquist et al. 2012.¹ Ballona Wetlands SAC memo, Oct 15, 2008.²
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- 2009** » PWA Revised Alternative 5 (RevAlt5)
PWA produces RevAlt5: continuous slope from subtidal to upland to accommodate SLR; reduced meander amplitude; cost/infrastructure-constrained. Companion document: Ballona Wetlands Restoration: Planning for Sea Level Rise (Garritty, Lowe & Haltiner, 2009).
Bergquist et al. 2012, US EPA Climate Ready Estuaries Program.¹
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Project Timeline since 2010

- 2011** USACE Notice of Intent (NEPA scoping)
Federal Register notice of intent to prepare a joint EIS/EIR for the Ballona Wetlands Restoration Project (May 20, 2011). Formal NEPA review begins, with USACE Los Angeles District and CDFG as co-lead agencies.
Federal Register, Vol. 76 No. 98 (May 20, 2011), p. 29225.¹⁰
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2011	SCCWRP Technical Reports 671 and 683 published Dark et al., Historical Ecology of the Ballona Creek Watershed (TR 671); Liu et al., Contemporary and Historical Hydrologic Analysis (TR 683). Provide the historical-baseline narrative subsequently cited throughout the EIR/EIS, anchored in NOAA T-Sheet No. 1432b (1876). The earlier Hancock federal survey (1857–58) and the Courtney Partition Map (1867–68) are not analyzed in TR 671 or in the administrative record built upon it — a gap documented in the Ballona Creek Terminus Report (McMahon, v5.72, §7.1–7.4).²³ SCCWRP TR 671, TR 683.^{13,14}
2012	USACE Special Public Notice (Aug 24, 2012) USACE Los Angeles District publishes scoping public notice. Project description explicitly includes: "Removal of existing Ballona Creek levees and realignment of Ballona Creek to restore a more meandering channel." First federal-record statement of the meander objective. USACE LA District, Ballona NOI Public Notice (extended), Aug 24, 2012.¹⁵
2012	Bay Foundation / US EPA Climate Ready Estuaries study Bergquist, Pal, Trott, Brown, Wang & Luce, Climate Change Implications for Ballona Wetlands Restoration (Sept 2012; ed. Karina Johnston). Models Alt5 and RevAlt5 under SLR scenarios — the most explicit public technical record of both designs. SMBRF / US EPA, Dec 12, 2012.¹
2017	Draft EIS/EIR released (Sept 2017) CDFW + USACE publish joint Draft EIS/EIR. Three action alternatives evaluated; Alternatives 1 and 2 both specify "a sinuous (i.e., non-linear) Ballona Creek channel with two primary meander-shaped bends" — the direct lineal descendant of PWA Alt5/RevAlt5. Alternative 3 (Levee Culverts and Oxbow) leaves the channel as-is. Public comment period opens. CDFW Draft EIS/EIR, 2017.^{3,4}
2018	Public comment period closes Heal the Bay, Friends of Ballona Wetlands, and the Wetlands Coalition file formal comments supporting Alternative 1. Defend Ballona Wetlands, Grassroots Coalition, and others oppose the full-tidal restoration design. Heal the Bay Draft EIR Comments, Feb 7, 2018.¹⁶
2020	Final EIR certified (Dec 29–30, 2020) CDFW certifies the Final EIR and selects Alternative 1 — Full Tidal Restoration with a phasing commitment. Project broken into 35 construction sequences across two phases. CDFW Final EIR; Defend Ballona Wetlands petition, Jan 28, 2021.^{4,17}

- 2021** CEQA litigation filed (Jan 2021)
Four lawsuits filed by environmental groups (Defend Ballona Wetlands; Grassroots Coalition / Ballona Ecosystem Education Project; Ballona Wetlands Land Trust; others) challenging the EIR.
Defend Ballona Wetlands Petition for Writ of Mandate, Jan 28, 2021.¹⁷ Grassroots Coalition v. CDFW.⁵
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- 2021** State Coastal Conservancy funds CDFW design + permitting
Nov 30, 2021 — Conservancy enters agreement granting CDFW up to \$1,692,360 for design and permitting of the restoration project.
CDFW Ballona-EIR project page.⁷
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- 2023** » Superior Court ruling (May 17, 2023) — flood-capacity error
Judge James C. Chalfant orders CDFW to set aside its certification of the Final EIR because it "failed to disclose and analyze flood control design parameters" associated with proposed levees. The EIR had relied on a 46,000 cfs design figure inherited from the 1930s channel configuration; the controlling federal record (USACE Feb 1979 hydrologic analysis) establishes 68,000 cfs as the Standard Project Flood, with ~72,000 cfs of channel conveyance capacity computed for the upstream reach at Lincoln Boulevard Bridge (a hydraulic capacity figure, not a design standard). CDFW must prepare a new, legally adequate EIR if it chooses to proceed. Court rejects all other petitioner challenges to the EIR's analysis.
Grassroots Coalition v. CDFW, LASC Judge Chalfant, May 17, 2023.⁵ LA Times, May 30, 2023.⁶ USACE 1979 hydrologic analysis as compiled in McMahon, Ballona Creek Terminus Report, v5.72, §7.2.²³
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- 2023** EIR decertified (Sept 28, 2023)
CDFW formally decertifies the EIR per the court order and begins preparing a Recirculated/Revised EIR (rEIR) addressing the new flood-control design parameters.
CDFW Region 5 Ballona-EIR page.⁷
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- 2024** Sequences 1 & 2 advanced toward final design
CDFW uses Conservancy grant funds to advance Sequences 1 and 2 of the restoration project toward final design and prepare draft permit applications. Update of flood modeling underway. USACE Section 408 permit and LACFCD coordination required to modify the federal Ballona Creek channel and levee system.
CDFW Ballona-EIR page (status update).⁷
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- 2025** Revised EIR scoping & flood-modeling update
Scoping meetings held, public input solicited, initial administrative drafts of the revised EIR prepared in accordance with the May 2023 court order. Updated flood modeling reflects the increased design discharge (46,000 – 68,000 cfs) and forces re-engineered channel cross-section and meander geometry.
CDFW Ballona-EIR project page.⁷
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April 20,
2026

» SCCWRP Corrigenda to Dark et al. (2011) issued

The authors of SCCWRP Technical Report #671 (Dark et al., 2011) issue a formal Corrigenda explicitly acknowledging Tom McMahon "for careful review of the report" and instructing that the corrections "be considered an updated and superseding version of the original report." Substantive corrections include: (i) withdrawal of the "series of earthquakes" before 1825 narrative (could not be confirmed); (ii) withdrawal of the generalized "three years of heavy rains" framing (only the 1825 LA-River-course-change event remains supported); (iii) correction of the agency responsible for the 1876 T-sheet (United States Coast Survey, not USGS); (iv) correction of "Regan 1917" to Reagan 1917; (v) correction of Figure 22 caption to reference Hall (1888); plus multiple bibliographic corrections (Manies 1997; Grossinger and Askevold 2005; Hansen and Jackson 1889; LAT 1887/1906/1914; Gumprecht 1999). The Corrigenda directly affects narratives carried into the EIR document set.

SCCWRP Corrigenda, April 20, 2026.²⁶ McMahon, Citations to Dark et al. (2011) in the Ballona Wetlands Restoration Project EIR Document Set, April 21, 2026.²⁷

2026

Revised EIR public-comment cycle (anticipated)

rEIR comment period anticipated. The recent re-introduction of channel-meander geometry into the project description is a hydraulic redesign of the original 2008 PWA Alt5 / 2009 RevAlt5 concept — adapted to the corrected 68,000 cfs design flow rather than a new restoration idea.

CDFW Region 5 Ballona-EIR page.⁷

Why Engineered Meanders Are Being Re-Computed Now

Engineered channel meanders have been part of the project description since the 2008 PWA Feasibility Report. What the 2023 Chalfant ruling forced is a recomputation of the engineered channel's geometry under corrected flood-control parameters. Three drivers explain the recent re-engineering:

1. Court-ordered flood-capacity correction. The May 17, 2023 ruling found the EIR "failed to disclose and analyze flood control design parameters." The corrected design flow (~68,000 cfs vs. the EIR's earlier ~46,000 cfs) requires a wider, more hydraulically capable channel — including reconsidered meander radii and floodplain geometry.^{5,6}
2. Sea-level rise migration corridor. RevAlt5's continuous-slope concept (subtidal – upland) is the design feature that allows habitats to migrate landward as sea levels rise. CDFW's project page emphasizes this is "one of the first restoration designs to accommodate sea level rise with gently sloping earthen levees."⁷
3. Section 408 federal permit constraints. Modifying the federally authorized LACDA project (Ballona Creek channel + levees) requires a USACE Section 408 permission obtained through LACFCD. The geometry of any meandered channel must satisfy Section 408 review of the federal flood-control project's performance.^{15,18}

It is therefore accurate to say the 2026 revised EIR is not proposing a brand-new meander concept; it is updating the 2008–2009 PWA Alt5/RevAlt5 channel design to a higher design discharge mandated by the court, while retaining its core principle: replace the concrete flood-control channel with a set-back earthen-levee system framing an engineered sinuous creek. This is the insertion of meanders into a designed channel and floodplain — not the restoration of a meandering creek that historically ran to the sea.

Historical Baseline: What Is Actually Being Inserted

The terminology used in this report is anchored in the documentary baseline established by the Ballona Creek Terminus Report (McMahon, v5.72, Feb 28, 2026), which evaluates primary cartographic and documentary evidence for the historic hydraulic character of the Ballona terminus.²³ Five findings of that report frame the present "insert engineered meanders" terminology and are summarized below.

Finding 1 — Federal survey evidence. The earliest official government survey of Rancho La Ballona (Henry Hancock, 1857–58, certified by U.S. Surveyor General Mandeville Sept 19, 1858; re-certified by Hardenbergh Nov 1872) characterizes the terminus as an "interior lake" whose "connection with the sea is often obstructed." Inlet dimensions of 5–6 feet and a documented lagoon extent of approximately 1.6 miles inland are consistent with an intermittently closed coastal lagoon — not a permanent river outlet — observed approximately 32–33 years after the 1825 LA River avulsion.²³

Finding 2 — Court-certified land classification. The 1867–68 Courtney Partition Map, prepared in District Court Case No. 965 and based explicitly on the Hancock survey, classified only a narrow coastal fringe as fourth-class "Lands in Bay." Interior lands were designated first-class irrigable or second-class dry farming property — confirming limited tidal penetration and a productive agricultural interior wholly inconsistent with persistent estuarine conditions. The partition proceeding was adversarial with fiduciary referees and produced no documented landowner objection to the classifications.²³

Finding 3 — Convergent historical accounts. First-hand testimony (Warner, 1876; Guinn, 1915; eyewitness accounts compiled by Reagan, 1917) documents that during the Spanish Colonial period the LA River's predominant course ran southward through the Dominguez Gap to San Pedro Bay, and that the 1815–1825 avulsion toward Ballona was a temporary anomaly. The 1825 flood restored rather than created the predominant southward route.²³

Finding 4 — Independent spring-fed hydrology. During the documented Spanish Colonial period and after 1825, the Ballona watershed was sustained by an independent freshwater system. Historical mapping (SCCWRP 2011) identifies approximately 45 freshwater springs within the watershed; order-of-magnitude estimates based on 19th-century measurements (e.g., Hall 1888) suggest combined discharge on the order of several million gallons per day ($\approx 2\text{--}5$ MGD), with a 3.5–7.5 MGD upper-bound sensitivity case — a synthesized estimate, not a basin-wide measured total.^{24,25} The Centinela Springs (323,000–1,616,000 gpd including developed yields, 1888–1895) and the Kuruvungna/Tongva springs at University High School (22,000–56,000 gpd, still active in 2026; 8,000–10,000 years of indigenous use) are documented contributors.²⁴ Modern field measurements indicate a reduction on the order of $\sim 95\%+$ relative to historical estimates: the SCCWRP 2011 field survey identified 29 active springs aggregating $\sim 13,000$ gpd, with springs now contributing only $\sim 2\%$ of dry-season baseflow (the remainder is urban runoff).²⁵

Finding 5 — Pattern of source omission, now compounded by formal Corrigenda. Modern restoration planning relied primarily on NOAA T-Sheet No. 1432b (1876) and on Dark et al., SCCWRP TR 671 (2011); the earlier Hancock (1857–58) and Courtney (1867–68) federal/court

records are not reflected in the EIR/EIS administrative record. These earlier records carry chronological precedence and federal survey authority. The May 2023 Chalfant ruling and September 2023 decertification demonstrate that evidentiary gaps materially affect CEQA compliance.²³ On April 20, 2026, the authors of TR 671 issued a formal Corrigenda — specifically acknowledging Tom McMahon's review — that withdraws the "series of earthquakes before 1825" and "three years of heavy rains" causal narrative used in Draft EIS/EIR Section 2.3.7, corrects the agency identification for the 1876 T-sheet (United States Coast Survey, not USGS), and instructs that the Corrigenda "be considered an updated and superseding version of the original report." The companion citation analysis identifies 75 direct citations to TR 671 across the EIR document set (63 body-text-class); a subset of these citations — particularly those relying on the pre-1825 causal framing — are directly affected by the corrected facts.^{26,27} The withdrawn narrative is also affirmatively contradicted, not merely unconfirmed, by the Lynch (1931) MWD rainfall record — Appendix D, Table 9 indices of ≈ 45 , ≈ 65 , ≈ 75 , and ≈ 35 for 1825–1829 indicate a drought period rather than three consecutive years of heavy rains — and by the Crandell (1994) 1815–1825 debris-dam mechanism, in which no earthquakes are implicated.^{28,29,30}

Why this matters for the meander discussion. The 2008 PWA Alt5 / 2009 RevAlt5 design — and its 2017 EIR descendants (Alts 1 and 2) — specifies a sinuous channel with engineered meander-shaped bends within a re-graded floodplain. That geometry is a 21st-century engineering construct. It does not correspond to the documented 19th-century hydrologic condition: a watershed-sustained terminal lagoon with intermittent ocean connection, limited inland tidal extent (~ 1.6 miles), local watershed flows (~ 130 sq mi), and natural inlet closure dynamics. The channelization that was completed c. 1938 severed the spring-fed upland $\rightarrow$ terminal lagoon connection; restoration planning that focuses exclusively on tidal hydrology without addressing the near-total loss of the watershed's original freshwater base addresses one disturbance while ignoring an equally fundamental one.²³

Strength of Evidence: Spring Hydrology

The spring-hydrology component of the historical baseline rests on three lines of evidence with different evidentiary weight, summarized here so that downstream readers can calibrate confidence appropriately:^{23,24,25}

Claim	Evidentiary basis	Strength
~45 springs mapped 1850–1890	Originally anchored to SCCWRP 2011 (Dark et al., TR 671). TR 671 is now under formal Corrigenda (April 20, 2026); the spring inventory itself is not specifically corrected, but the underlying report is no longer presumptively authoritative. Independently corroborated by Hall (1888) and the Reagan (1917) compilation.	Moderate–strong — inventory itself uncorrected and independently corroborated; only the reliability of the originating report (TR 671) is reduced post-Corrigenda
Order-of-magnitude historical flow (≈ 2 –5 MGD; 3.5–7.5 MGD upper bound)	Triangulated to Hall (1888) miner's-inch measurements and individual spring records (e.g., Centinela 323k–1,616k gpd 1888–1895; Kuruvungna 22k–56k gpd).	Moderate–strong — synthesized aggregate, not a measured basin total

Claim	Evidentiary basis	Strength
~2% current contribution to dry-season baseflow	2011 SCCWRP field survey: 29 active springs, ~13,000 gpd aggregated; ~98% of current creek baseflow is urban runoff.	Strong — directly measured
Groundwater depletion / artesian → pumped transition	Documented 150+ ft water-table decline at Centinela by 1930s; consistent with West Basin overdraft history and saltwater intrusion record.	Strong — historically corroborated
Numeric '96–98% loss' figure	Apples-to-oranges comparison of synthesized historical aggregate (≈2–5 MGD) against measured modern subset (~13,000 gpd from 29 springs). Directionally correct but numerically fragile.	Moderate — directionally correct, attackable in litigation
Spring discharge dominated terminal lagoon hydrology vs. runoff / episodic river input / tidal exchange	Spatially inferred. Many mapped springs are in the Beverly Hills / La Cienega / Baldwin Hills foothills; explicit flow-path analysis from foothill springs to the lower lagoon is not yet quantified in the cited record.	Conceptually valid — needs flow-path analysis for rigor

Position summary. The spring evidence robustly establishes (i) that springs were widespread, (ii) that they contributed meaningful freshwater, and (iii) that they are now largely gone. The evidence does not by itself prove that spring discharge dominated Ballona's terminal lagoon hydrology relative to runoff, episodic river input, or tidal exchange; that argument requires explicit flow-path analysis from the foothill springs to the lower lagoon and is the locus where opposing technical review is most likely to focus. The conservative, defensible framing adopted in this report is therefore that spring discharge was a material, watershed-internal freshwater input — sufficient to sustain a productive terminal lagoon during the 32–33 years between the 1825 LA River avulsion and Hancock's 1857–58 survey — without claiming numerical dominance over all other inputs.^{23,24,25}

Implications of the April 2026 SCCWRP Corrigenda

Three EIR-relevant items at a glance. Of the items addressed by the April 20, 2026 Corrigenda, three have direct administrative-record consequences for the Ballona Wetlands Restoration Project EIR document set: (i) a companion citation analysis identifies 75 direct citations to Dark et al. (2011) across the EIR document set — 63 of them body-text-class — distributed across 9 of the 24 EIR PDFs;²⁷ (ii) the withdrawn "series of earthquakes before 1825" and the unsubstantiated "three years of heavy rains" causal narrative are the specific factual claims used in the Draft EIS/EIR (Section 2.3.7, Alternative 11) to justify the EIR's pre-1825 LA River routing into Ballona; (iii) the misidentification of the U.S. Coast Survey as the "USGS" for the 1876 T-sheet affects the institutional provenance of NOAA T-Sheet No. 1432b that the EIR uses as a primary historical-baseline document. The remainder of this section walks through each item in detail.

On April 20, 2026, the authors of Historical Ecology of the Ballona Creek Watershed (Dark et al., SCCWRP Technical Report #671, 2011) issued a formal Corrigenda that explicitly acknowledges Tom McMahon for review of the report and instructs that the corrections "be considered an updated and superseding version of the original report."²⁶ Because TR 671 is the historical-ecology document most heavily relied upon by the Ballona Wetlands Restoration Project EIR document set, the Corrigenda has direct administrative-record implications. The Corrigenda was issued following the pre-corrigendum analysis circulated as McMahon (April 21, 2026, v1.13), Earthquakes, Heavy Rains, and the 1825 Los Angeles River Avulsion: Citation, Logical Consistency, and Internal Contradiction Issues in Published Historical Ecology Literature, which compiled the affirmative evidence — from Reagan (1917), Lynch (1931), Crandell (1994), and Topozada et al. (2002) — showing that the "series of earthquakes before 1825" and "three years of heavy rains" framing was not merely uncited but contradicted by the contemporaneous record.^{28,29,30,31}

Footprint in the EIR document set

A companion citation analysis identifies 75 direct citations to Dark et al. (2011) across the EIR document set, distributed across 9 of 24 EIR PDFs (~14,800 pages). Of these, 63 are body-text-class (parenthetical, narrative, footnote, and figure-caption citations relied on for substantive findings) and 12 are reference-list entries.²⁷ Density is concentrated in a small number of locations:

EIR location	Citations	Substantive use of TR 671
Draft EIR Appendix B3 §2.2.2 — Historical Ecology (pp. B3-19 to B3-21)	7 in 3 pages	Densest concentration. Establishes the historical-ecology baseline used to justify the project's habitat targets.
Final EIR Volume 5	13	Highest single-volume count. Includes responses to comments and the historical-baseline characterization.
Final EIR Volume 6	9	Second-highest. Continued reliance on TR 671 narratives in agency responses.
Final EIR Vol 1, footnote 16 (p. 2-38)	1 (specific)	Only citation referencing TR 671 Figure 20 + Table 6 specifically — used for the percentage breakdown of historical wetland types.

EIR location	Citations	Substantive use of TR 671
Draft EIS/EIR §2.3.7 — Alternative 11: 19th-Century Wetlands (p. 358)	—	Uses the now-withdrawn "earthquakes" + "three years of heavy rains" pre-1825 narrative as the causal framing for the alternative.
CDFW response (Vol 1 fns. 10, 31; Vol 5 p. 2-3512)	3+	Cited specifically for historic saltwater intrusion and historical-ecology framing in agency responses to comments.

Specific narratives now withdrawn or corrected

Pre-1825 "series of earthquakes." Withdrawn by the Corrigenda; the authors could not confirm. This causal element appears in the Draft EIS/EIR §2.3.7 framing of Alternative 11 and in derivative descriptions of the pre-1825 hydrologic baseline (Lynch 1931 Appendix D, Table 9 rainfall indices of ≈ 45 –75 across 1825–1829 indicate a drought rather than three rainy years; Crandell 1994 documents an 1815–1825 debris-dam causal chain in which no earthquakes are implicated; the only earthquake in the 1825–1828 period — the $\approx M5.5$ event of September 24, 1827 (Toppozada et al. 2002) — post-dates the avulsion by more than two years).^{26,27,28,29,30,31}

"Three years of heavy rains" framing. Withdrawn as a generalized statement; only the specific 1825 heavy-rains event associated with the LA River course change to Ballona remains supported. EIR text relying on the broader "three years" framing is no longer supported by the original report's authors.²⁶

USGS attribution for the 1876 T-sheet. Corrected to United States Coast Survey. Several EIR citations reference the T-sheet under the incorrect agency attribution; the corrected provenance does not weaken the T-sheet itself but reinforces that the chronologically prior Hancock (1857–58) federal survey is also part of the federal documentary baseline that the EIR record does not engage.²⁶

Figure 22 / Hall 1888 attribution. Corrected from "Hall (1887)" to Hall (1888), and "Regan 1917" corrected to Reagan 1917. These corrections re-anchor the primary 19th-century cartographic and narrative sources for the spring inventory and the LA-River-avulsion history away from miscited derivatives and back to their original authors.²⁶

Bibliographic corrections. Manies (1997), Grossinger and Askevold (2005), Hansen and Jackson (1889), LAT (1887/1906/1914), and Gumprecht (1999) all receive bibliographic corrections in the Corrigenda. Downstream EIR citations that pass through TR 671 inherit the original errors and should be checked against the corrected entries.²⁶

Implication for Finding 5 and the EIR's pre-1825 narrative

Finding 5 of the Terminus Report originally identified a pattern of source omission: the EIR/EIS administrative record relied primarily on NOAA T-Sheet No. 1432b (1876) and on Dark et al. (TR 671, 2011), without engaging the chronologically prior federal-survey record (Hancock 1857–58; Courtney 1867–68).²³ The April 2026 Corrigenda compounds that finding in two ways. First, the single

non-Hancock source most heavily relied upon by the EIR is now under formal Corrigenda from its own authors, with the corrections designated as superseding the original report. Second, the specific pre-1825 causal narrative used in Draft EIS/EIR §2.3.7 (Alternative 11) — namely the "earthquakes" plus "three years of heavy rains" framing — has been withdrawn. The EIR's pre-1825 baseline therefore now rests on (i) a corrected source whose authors have re-anchored attributions to Hall (1888) and Reagan (1917), and (ii) a withdrawn causal narrative. A subset of the 75 direct citations to TR 671 (63 body-text-class) — particularly those relying on the pre-1825 causal framing — is directly affected by the corrected facts and warrants re-examination in the revised EIR currently in preparation under the May 2023 Chalfant order. The remaining citations are not necessarily disturbed by the Corrigenda on their face.^{5,7,26,27}

Effect on this report's evidentiary anchors. Where this report previously cited SCCWRP TR 671 as the primary anchor for the spring inventory and 19th-century distributional mapping, the spring inventory is re-anchored in this revision to Hall (1888) and the Reagan (1917) compilation, with TR 671 cited as supporting rather than primary. The 2011 SCCWRP field survey result (29 active springs, ~13,000 gpd, ~2% of dry-season baseflow) is a directly measured modern dataset and is unaffected by the Corrigenda; it remains rated Strong — directly measured in the Strength of Evidence table.^{23,24,25,26}

Proponents and Roles

Entity	Role
California Department of Fish & Wildlife (CDFW)	CEQA lead agency. Owns the BWER. Selected Alternative 1 (Full Tidal) in 2020.
U.S. Army Corps of Engineers — LA District	NEPA co-lead via 2000 FCMA. Section 408 permit authority for LACDA modifications.
State Coastal Conservancy	Funded SAC, alternatives development (2004, 2008+), and 2021 design-and-permitting grant (\$1.69M).
State Lands Commission	Co-lead state agency with DFG; jointly owns project site with CDFW.
LA County Flood Control District (LACFCD) / LA County Public Works	Operator/maintainer of the federal Ballona Creek channel & levees. Co-applicant for USACE Section 408 permission.
Philip Williams & Associates (PWA)	Original author of Alt5 (2008) and RevAlt5 (2009) — the source of the meandering-channel design concept.
Environmental Science Associates (ESA / ESA PWA)	Engaged in 2005; developed restoration engineering, hydraulic / hydrodynamic modeling; prepared Draft and Final EIR.
SCCWRP — Ballona Wetlands Science Advisory Committee	12-scientist panel convened 2004; endorsed Alt5/Alt4 forward on Oct 15, 2008.
The Bay Foundation (TBF) / Santa Monica Bay Restoration Foundation	Modeled Alt5/RevAlt5 under SLR scenarios for US EPA Climate Ready Estuaries (2012). Co-partner in restoration coalition.
Friends of Ballona Wetlands (FBW)	Long-time proponent of full-tidal restoration; party to original 1990 settlement that produced the BWER acquisition.
Heal the Bay	Public advocate for Alternative 1 during 2018 comment period.
Defend Ballona Wetlands; Grassroots Coalition; Ballona Wetlands Land Trust; Ballona Ecosystem Education Project	Petitioners challenging the EIR. Lawsuits filed Jan 2021; partial win May 2023 on flood-control disclosure.

Entity	Role
Tom McMahon (independent investigator)	Author of the Ballona Creek Terminus Report (v5.72, Feb 28, 2026) and companion spring-hydrology analyses (Apr 2026), documenting the federal-survey baseline (Hancock 1857–58, Courtney 1867–68), the spring inventory (~45 mapped springs; ~2–5 MGD synthesized historical discharge; 29 active springs / ~13,000 gpd / ~2% of baseflow per the 2011 SCCWRP field survey), and the 68,000 cfs SPF / 46,000 cfs EIR specification gap. Acknowledged by name in the SCCWRP TR 671 Corrigenda (April 20, 2026) for review that triggered the corrections. Author of the companion Citation Analysis Report (April 21, 2026) cataloging the 75 EIR citations to Dark et al. (2011). Frames the historical baseline used in this report.

DRAFT

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All numbered citations correspond to footnote markers in the body of this report. URLs are clickable.

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Research Project. Acknowledges Tom McMahon for review and instructs that the corrections "be considered an updated and superseding version of the original report." Withdraws the pre-1825 "series of earthquakes" and generalized "three years of heavy rains" narratives; corrects the 1876 T-sheet agency attribution to United States Coast Survey; corrects "Regan 1917" to Reagan 1917 and Figure 22 to reference Hall (1888); plus bibliographic corrections (Manies 1997; Grossinger and Askevold 2005; Hansen and Jackson 1889; LAT 1887/1906/1914; Gumprecht 1999). Issued as a prepended Corrigenda to SCCWRP TR 671:

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27. McMahon, T. (April 21, 2026). Citations to Dark et al. (2011) in the Ballona Wetlands Restoration Project EIR Document Set — Citation Analysis Report. Playa del Rey, CA. Catalogs 75 direct citations to SCCWRP TR 671 across 9 of 24 EIR PDFs (~14,800 pages); 63 body-text-class and 12 reference-list. Densest concentrations: Draft EIR Appendix B3 §2.2.2 (7 citations in 3 pages); Final EIR Vol 5 (13); Final EIR Vol 6 (9). Identifies the now-withdrawn pre-1825 narrative in Draft EIS/EIR §2.3.7 (Alternative 11) as directly affected by the SCCWRP Corrigenda.

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Revision History

Version	Changes
v1.0	Initial timeline.
v1.1	SAC dual-alternative correction; risk-ranking table added.
v1.2	Terminus Report alignment; spring-hydrology evidence framing.
v2.0	SCCWRP Corrigenda re-anchoring; spring-inventory provenance shifted toward Hall (1888) and the Terminus Report; Finding 5 rewritten; Strength of Evidence ratings adjusted.
v2.1	Strengthened Finding 5 and the Corrigenda section with Lynch (1931) rainfall data, Crandell (1994) debris-dam mechanism, and reference to the pre-corrigendum earthquakes/rains analysis (McMahon Apr 21, 2026, v1.13). Citations [28]–[31] added.
v2.2	Harmonized the closing colophon with the cover authorship statement; compilation now attributed to the author working under the triple-AI methodology rather than to an AI system.
v2.3	Clarified the Strength cell of the spring-hydrology evidence table so the post-Corrigenda downgrade applies only to the originating report (TR 671), not to the ~45-spring inventory itself, which remains independently corroborated by Hall (1888) and Reagan (1917).
v2.4	Relocated the revision history from the cover meta-table to a dedicated section preceding the closing colophon. No content changes elsewhere.

Version	Changes
v2.5	Defensive wording adjustments. Replaced falsifiable absolute language ("never had" / "never carried") with documentary-evidence framing ("no documentary or survey evidence indicates"). Qualified the intermittently-closed-coastal-lagoon classification as the best-supported interpretation of the mid-19th-century documentary record. Narrowed the Corrigenda citation-impact scope from "each of the 75 citations" to the affected subset (those relying on pre-1825 causal framing). Added a one-sentence Scope of this report clarification to the Executive Summary.
v2.6	Version-string consistency fix. Corrected the Executive Summary's opening sentence ("v2.0 framing" → "v2.6 framing") and its closing sentence ("Revision 2.0" → "Revision 2.6") so the in-body version markers match the cover Version field. No analytical or evidentiary content changed.
v2.7	Executive Summary restructure. Removed the SCCWRP Corrigenda framing paragraph from the ES (a one-paragraph three-item EIR hook was added to the dedicated Implications of the April 2026 SCCWRP Corrigenda section, where the underlying narrative already lived). Removed the Terminology Note paragraph from the ES and promoted it to its own H2 section, 'Terminology and Documentary Baseline,' positioned between the ES and the Origin of the Engineered-Meander Proposal section. The Executive Summary now opens with Scope of this report, followed directly by the Alt5/RevAlt5 origin narrative and Three Findings at a Glance. No factual content was added or removed.

Compiled April 30, 2026 by the author under the triple-AI methodology described on the cover. The current revision (v2.7) and prior revisions are summarized in the Revision History table above. Document scope: official CDFW EIR reference materials, USACE LA District notices, State Coastal Conservancy board records, SCCWRP technical reports, the Bay Foundation / US EPA climate study, California Superior Court filings, and the Ballona Creek Terminus Report (McMahon, v5.72, Feb 28, 2026). Historical baseline terminology — "terminal lagoon complex," "intermittently closed coastal lagoon," "spring-fed upland watershed," "seasonal meanders, marsh distributaries, and lagoon inflows" — follows McMahon (2026). Citations preserve original URLs for reader verification.